
**AN UPDATE ON
WORLD SUGAR SUPPLY AND DEMAND
1980 AND 1985**

**UNITED STATES
DEPARTMENT OF
AGRICULTURE**

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FOREWORD

This publication is a supplement to "Report on World Sugar Supply and Demand - 1980 and 1985". The historical data base for supply and demand has been expanded to include 1974/75 and 1975/76, thereby giving a broader base for analysis. The present report, known as "Report on World Sugar Supply and Demand - 1980 and 1985 - An Update" had 2 more years of data in addition to the 20 years utilized in the first report.

Sugar is a very volatile commodity. It is produced almost worldwide, and is highly regulated in many of the producing and consuming countries. Therefore, future supply and demand may be influenced significantly by government or intergovernmental programs, as well as the usual factors, such as weather and prices. The projections in this "Update" did not attempt to predict the influence of any such programs.

This "Update" was done by the Development and Resources Corporation of Sacramento, California for the U.S. Department of Agriculture. Leslie C. Hurt, Sugar and Tropical Products Division, Foreign Agricultural Service, USDA, served as Project Leader for the study.

Use of commercial and trade names does not imply approval or constitute endorsement by USDA or the Foreign Agricultural Service.

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INTRODUCTION

The world sugar market from 1954/55 to 1972/73 was relatively static with very few unexpected changes in supply or demand.¹ In late 1973 and 1974, the sugar supply and demand situation went through some rapid gyrations. World sugar prices increased six times over a 10- to 12-month period. There was speculative buying, the sugar market was thrown into disequilibrium, and the future of the world sugar market was uncertain. This period was followed by a period of excess supply from 1975 to the present (1978), when prices fell below production costs in some countries and sugar went begging for a market. The Foreign Agricultural Service of the U.S. Department of Agriculture set out to investigate the world sugar situation in detail beginning in 1974 and culminating with this report. FAS was assisted by Development and Resources Corporation, an international consulting company headed by David E. Lilienthal.

The investigation was conducted in two separate phases. Phase I focused on the collection, electronic data processing, verification, and documentation of consistent data series related to production and consumption of sugar in foreign countries. The data were published in October 1976 in Statistical Bulletin No. 562, entitled "Sugar: World Supply and Distribution, 1954/55-1973/74."

Phase II used the data generated in Phase I to project future prospects for foreign supply and demand in 1980 and 1985. Twenty-one major countries and six country groups such as OPEC were analyzed in detail. These countries and country groups account for a majority of the world's consumption, production, and trade. Countries not analyzed individually or included among the country groups were aggregated into a "Rest of the World" category so that the total world supply and demand situation could be examined.² The results of this investigation were published in a November 1977 report entitled "Report on World Sugar Supply and Demand, 1980 and 1985."

¹Sugar as defined in this study includes all centrifugal sugar.

²The U.S. was included in this category since a major goal of this study was to project sugar supply and demand utilizing the trade flows of major foreign countries and the emphasis of FAS was toward providing U.S. producers with analysis concerning foreign countries.

This report is an update of Phase II, and recalculates projections contained in the Phase II report by the use of an expanded data base to cover the years 1954/55 to 1975/76. This extended the data base by 2 years since the Phase II report utilized data from 1954/55 to 1973/74. The expanded data base is published in FAS publication FS3-77 entitled "World Sugar Supply and Distribution, 1954/55-1975/76."

The reason for expanding the analysis, given 2 additional years of data, was the absence of the price response of supply and distribution variables for some countries in the Phase II report. Utilizing data only through 1973/74 yielded projections of the relatively static years prior to 1973 and the sudden price increases of 1973 and 1974. The subsequent price decreases of 1975/76 were not reflected in the Phase II projections.

Figure 1 indicates the relationship between price data used in the Phase II and the Phase II update projections. With more data years reflecting price variation, it was hypothesized that a stronger statistical relationship between supply and distribution variables might be realized in the update.

The impact of High-Fructose Corn Syrups (HFCS) was not specifically addressed in this modeling effort. A detailed analysis of HFCS was contained in the Phase II report, which indicated that world production was concentrated in the U.S., EEC, and Japan and would be less than 4 million metric tons by 1985. While HFCS could be important to regional markets, it will probably account for less than 4 percent of world sugar production by 1985.¹

PROJECTION RESULTS

The equations utilized for the update were essentially the same as those utilized for Phase II, and they appear in Table 1. The one change is that no Type II equations (those testing exchange rates, exports and imports, substitute crops, and various dummy variables as explanatory variables) were utilized in the update projections. The type of equations used for each country appears in Table 1. As can be seen in Table 2, the statistical performances of the Type I equations were significantly improved by the addition of 2 years of data.

¹Based on world HFCS production of 3.8 million metric tons in 1985 compared to projected world sugar production of 100 million metric tons in 1985.

FIGURE I
ANNUAL AVERAGE WORLD SUGAR PRICES
1955-76

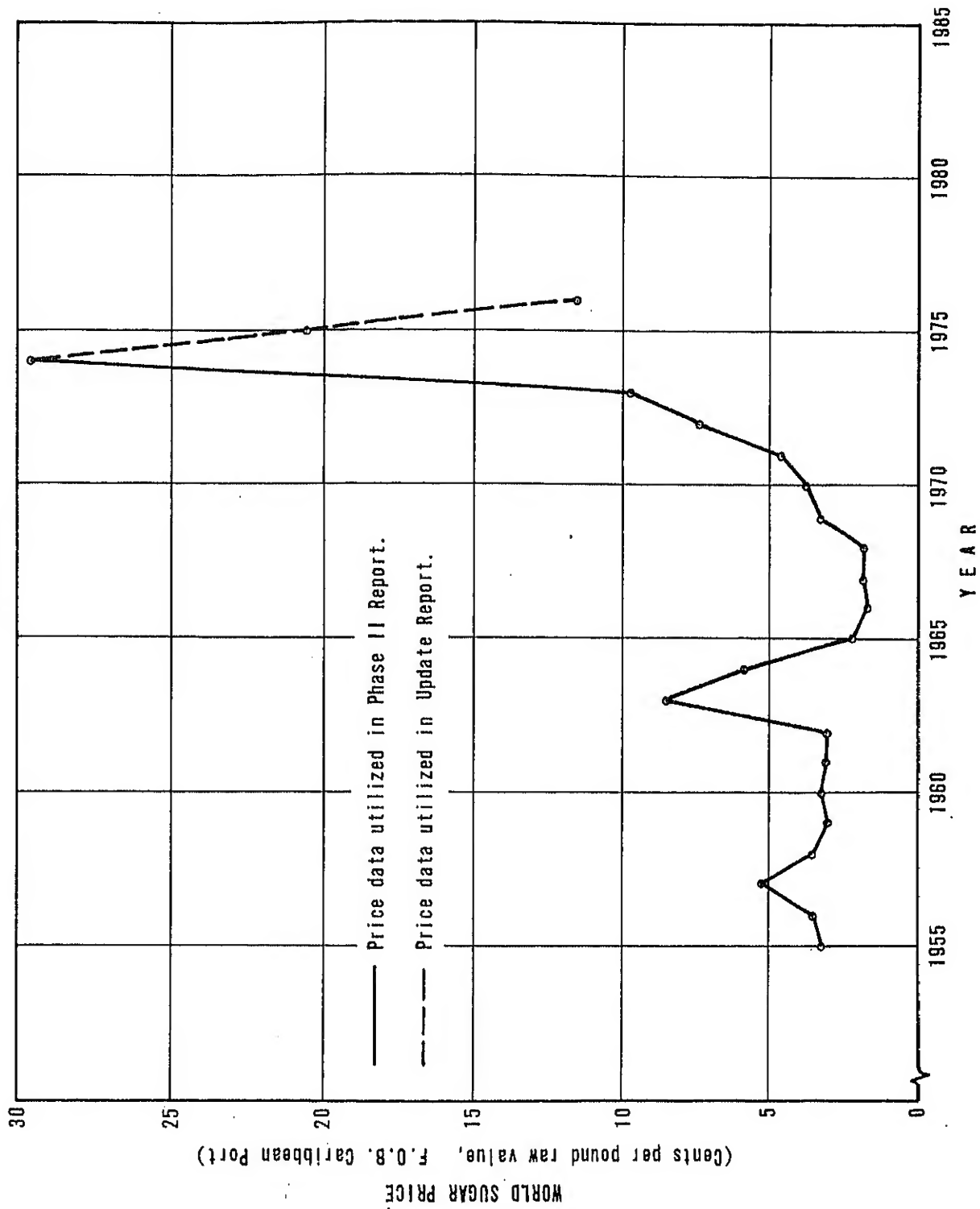


TABLE I

EQUATIONS USED IN PHASE II UPDATE WORLD SUGAR PROJECTIONS

TYPE I

Production and Hectarage

$$\begin{aligned} Q_p &= H_t Y_t \\ H_t &= b_o + b_1 R_t \\ R_t &= \sum_{k=1}^K \bar{K} P_{t-k} Y_{t-k} \end{aligned}$$

$$Y_t = a_o + a_1 \ln t$$

where: Q_p = quantity produced (thousand metric tons)

a_o, a_1, b_o, b_1 = estimated coefficients

P = price, FOB Caribbean port (cents/lb.)

H_t = hectares harvested (thousand)

R_t = expected returns per acre for sugar growers

Y_t = yields (metric tons/hectare)

K = distributed lag parameters

t = time, 1955 = 1

$\ln t$ = the natural log of the trend variable

Consumption

$$= c_o + c_1 \frac{I}{N} + c_2 P$$

Inventories

$$= g_o + g_1 \frac{S_{t-1}}{N} + g_2 P$$

where: Q_D = quantity demanded (thousand metric tons)

$c_o, c_1, c_2, g_o, g_1, g_2$ = estimated coefficients

C_t = quantity consumed (thousand metric tons)

S_t = quantities held in stocks at the end of a September to August crop year

$C_t \frac{I}{N}$ = per capita consumption

$\frac{I}{N}$ = per capita income

P = price, FOB Caribbean port (cents/lb.)

I = income (U.S. dollars)

N = population

t = time, 1955 = 1

TYPE III

$$Q_p, Q_c, S_t = \alpha_o + \alpha_1 t + \alpha_2 P$$

$$Q_p, Q_c, S_t = \beta_o + \beta_1 \ln t + \beta_2 P$$

where: Q_p = quantity produced (thousand metric tons)

Q_c = quantity consumed (thousand metric tons)

S_t = quantities held in stocks at the end of a September to August crop year

$\beta_o, \beta_1, \beta_2, \delta_o, \delta_1, \delta_2$ = estimated coefficients

P = price, FOB Caribbean port (cents/lb.)

TABLE 2^{1/}
EQUATIONS USED FOR PHASE II UPDATE PROJECTIONS

Country	Production	Consumption	Stocks
	-----	Equation Type-----	
France	I	I	I
Italy	III	I	I
United Kingdom	I*	III	III
Federal Republic of Germany	I	I	I
Argentina	I	I	I
Australia	I	I	I
Brazil	I	I	I
Central America and Caribbean	I*	I*	III
Cuba	III	III	I
Dominican Republic	I*	I	III
India	I*	III	I
Mexico	I	I	I
Philippines	I*	III	III
Republic of China	III	I*	I
South Africa	I*	III	I
Poland	I	I	I
Indonesia	I*	I	I
USSR	I*	I	I
Iran	I	I	I
Canada	I*	I	I
Japan	I*	I	I*
Spain	III	I	I
EEC	III	III	III
Eastern Europe	III	III	III
OPEC	III	III	III
Rest of World	III	III	III

^{1/} Projections for "Major Exporters" and "Other" country group categories were made by summing the projections for the individual countries within the group.

*Projections where Type III or II equations were used in Phase II and Type I equations were used in the update due to the improved statistical performance of Type I equations with the expanded data base.

The statistical results for the Type I and Type III equations (see page 4) are shown in Tables 3 and 4, respectively. The statistics shown are the estimated coefficients, the corresponding t statistics, and R^2 for each regressor used in making the projections. The t statistics appear below the coefficients in parentheses. In almost all cases lagged dependent variables were used in making projections so that the Durbin-Watson statistic (test for autocorrelation) is not listed in the following tables for any of the estimates.

The projections for hectareage, production, consumption, inventories, and demand for the individual countries and six country groups for 1980 and 1985 appear in Tables 5 and 6, respectively. Projections for the world are also included in these tables. In order to make world projections, a "Rest of the World" category was formed. This category consists of all countries not included in a country group.

The projections are made for 1980 and 1985 with price scenarios of 7, 15 and 23 cents per pound FOB Caribbean port. Only one equilibrium price can exist for 1980 and one for 1985. Supply and demand do not equal for price scenarios used in this study. However, fluctuations in supply and demand can be observed as they move toward equilibrium as prices rise or fall. The price utilized in this update is a constant 1976 price, whereas Phase II utilized a constant 1974 price.

The "Excess Demand" and "Excess Supply" categories in Tables 5 and 6 are simply excess supply available for export or excess demand to be met by imports.

TABLE 3
REGRESSION RESULTS FOR TYPE I EQUATIONS

1 of 3

PRODUCTION									
Country	Equation		Yields (Y_t)		R^2	Hectarage (A_t)		R^2	Notes
	a_0	a_1	b_0	b_1					
France	3.2716	1.0463 (2.839)	115,255.8	91,719.07 (6.787)	.30	115,255.8	91,719.07 (6.787)	.71	k = 1
Federal Republic of Germany	4.8016	.1153 (4.094)	160,703.875	4,704.0508 (7.059)	.48	160,703.875	4,704.0508 (7.059)	.74	k = 2
Argentina	1.9568	.9436 (5.240)	49,483.61	69,243.81 (5.200)	.63	49,483.61	69,243.81 (5.200)	.62	k = 4
Australia	6.5577	1.4712 (4.657)	63,079.3984	38,532.3906 (2.620)	.58	63,079.3984	38,532.3906 (2.620)	.30	k = 4
Brazil	5.0497	.1048 (5.681)	-16,088.2812	223,017.125 (6.683)	.67	-16,088.2812	223,017.125 (6.683)	.74	k = 4
Mexico	3.8807	.2724 (.5440)	405,744.312	46,620.7305 (4.674)	.04	405,744.312	46,620.7305 (4.674)	.76	k = 1
Poland	2.7668	.0734 (4.215)	411,577.125	584.3674 (1.624)	.53	411,577.125	584.3674 (1.624)	.14	k = 4
Iran	1.7662	.0867 (5.004)	96,800.0625	909.7405 (2.025)	.57	96,800.0625	909.7405 (2.025)	.18	k = 1
Philippines	4.6877	.1533 (.2049)	133,577.812	81,669.6250 (6.416)	.01	133,577.812	81,669.6250 (6.416)	.82	k = 1
Dominican Republic	4.6568	.1186 (5.081)	135,685.312	237.8121 (2.289)	.62	135,685.312	237.8121 (2.289)	.25	k = 4
USSR	1.7078	.0530 (3.922)	3,027,257.000	184,175.625 (1.327)	.48	3,027,257.000	184,175.625 (1.327)	.10	k = 3
South Africa	7.1481	.1668 (1.109)	180,351.500	37.0966 (.4919)	.11	180,351.500	37.0966 (.4919)	.02	k = 1
Canada	3.4696	.2306 (1.577)	33,070.5898	59.3341 (.8173)	.14	33,070.5898	59.3341 (.8173)	.04	k = 4
Japan	.4494	2.2087 (6.636)	9,105.5742	16,441.5898 (6.093)	.72	9,105.5742	16,441.5898 (6.093)	.69	k = 3
Indonesia	4.2402	.0792 (4.662)	67,817.25	21,772.9414 (7.605)	.63	67,817.25	21,772.9414 (7.605)	.82	k = 1
United Kingdom	3.6417	.6374 (4.851)	178,469.687	146.8624 (1.456)	.60	178,469.687	146.8624 (1.456)	.12	k = 4
India	.9744	.0381 (5.465)	2,331.714	10,343.1914 (2.369)	.61	2,331.714	10,343.1914 (2.369)	.23	k = 1
Central America and Caribbean	4.0888	.0325 (4.225)	374,039	1,148.2590 (2.616)	.47	374,039	1,148.2590 (2.616)	.30	k = 4

CONSUMPTION

TABLE 3 (Continued)

2 of 3

Equation		Income		Population		Per Capita Consumption		Price		R ²	
Country		d ₀	d ₁	R ²	f ₀	f ₁	R ²	c ₀	c ₁		c ₂
France		-28,087	12,024 (10.916)	.86	43.0956	.4759 (46.386)	.99	30.965	2.6840 (5.317)	-100.6600 (-.861)	.71
Italy		-8,338	6,372 (16.956)	.94	47.4027	.3923 (48.610)	.99	17.430	8.2460 (9.372)	-158.62 (-1.616)	.88
Federal Republic of Germany		-44,435	16,195 (9.230)	.81	50.0706	.6323 (16.195)	.93	29,031	2.7830 (2.405)	-370.7400 (-1.135)	.26
Argentina		1,436	1,494 (10.024)	.85	18.7100	.3166 (95.664)	.99	33,114	16.7990 (8.346)	-264.1700 (-1.047)	.86
Australia		-8,384	3,474 (8.100)	.77	8.9878	.2170 (157.404)	.99	53,961	1.683 (2.020)	-286.51 (-1.275)	.18
Brazil		-18,279	4,665 (7.371)	.86	55.9993	2.3578 (79.467)	.99	32,715	14.602 (9.612)	-208.7200 (-2.937)	.94
Dominican Republic		-264	128 (8.475)	.78	2.3535	.1089 (83.788)	.99	24,381	21.813 (3.141)	-108.0900 (-.595)	.47
Mexico		-2,418	2,268 (15.766)	.93	25.9193	1.5458 (29.953)	.98	25,460	20.7470 (16.685)	-117.53 (-2.969)	.95
Indonesia		-885	933 (6.475)	.68	79.0901	2.5056 (27.485)	.98	2,889	56.686 (4.096)	-207.3200 (-1.549)	.56
Iran		-6,299	8,774 (5.172)	.60	13.7338	5.1194 (7.672)	.76	18,077	18.911 (4.184)	-634.92 (-2.639)	.58
Canada		-7,653	5,807 (9.160)	.81	15.8252	.3398 (48.262)	.99	46,493	.1750 (.352)	-116.2300 (-.916)	.05
Japan		-82,942	19,642 (9.312)	.81	86.6575	1.1307 (46.699)	.99	15,327	5.1410 (6.018)	-271.81 (-1.707)	.74
Spain		-13,592	3,762 (8.496)	.78	28.3669	.3381 (55.053)	.99	16,564	9.561 (8.426)	-282.9400 (-2.208)	.87
Republic of China		-2,019	638 (16.292)	.93	8.5876	.3356 (93.194)	.99	4,735	25.561 (2.523)	-212.71 (-.6115)	.29
USSR		53,052	16,873 (11.562)	.87	196.7334	2.8543 (41.191)	.99	18,215	20.6130 (4.829)	-497.60 (-1.877)	.54
Poland		-9,685	10,488 (32.260)	.98	25.8652	2.4366 (16.624)	.93	20,773	3.4470 (21.731)	-81.56 (-1.8400)	.96
Central American and Caribbean		-111,025	383 (5.039)	.60	15.7074	3.1558 (5.049)	.71	13,190	347.2650 (10.845)	-109.99 (-1.767)	.90

α

INVENTORIES

TABLE 3 (Continued)

3 of 3

Equation		Per Capita Beginning Stocks		Equation		Per Capita Beginning Stocks		Price		R ²		
Country	ε ₀	ε ₁	$\frac{\text{Price}}{\epsilon_2}$	Country	ε ₀	ε ₁	$\frac{\text{Price}}{\epsilon_2}$	Country	ε ₀	ε ₁	$\frac{\text{Price}}{\epsilon_2}$	R ²
France	7,428	.2966 (1.609)	-238.59 (-1.400)	Republic of China	3,729	.5168 (2.523)	-145.566 (-.612)					.29
Italy	6,374	.3811 (2.215)	-72.38 (-.8746)	South Africa	7,023	.1829 (.800)	-23.726 (-.192)					.03
Federal Republic of Germany	3,889	.1838 (1.052)	-87.51 (-.766)	Poland	4,113	.3748 (1.422)	-11.726 (-.118)					.10
Argentina	5,368	.5316 (2.754)	-214.30 (-1.318)	Indonesia	121	1.0074 (16.622)	-12.955 (-.720)					.94
Australia	6,740	.6664 (3.022)	-68.56 (-.200)	Iran	3,099	.8702 (5.968)	-87.041 (-.575)					.78
Brazil	2,446	.8996 (9.867)	-76.425 (-1.034)	Canada	3,758	.5308 (2.926)	-32.745 (-.680)					.31
Cuba	89,429	.6094 (4.228)	-992.691 (-.270)	Spain	2,986	.5660 (2.841)	-60.944 (-1.228)					.35
India	934	.8276 (7.412)	-54.334 (-1.570)	USSR	1,695	.7469 (4.940)	-68.831 (-1.058)					.59
Mexico	1,890	.8778 (6.137)	-85.807 (-.992)	Japan	1,763	.1863 (.800)	-18.653 (-.676)					.07

TABLE 4

REGRESSION RESULTS FOR TYPE III EQUATIONS

Equation		Production (1000 mt)			Consumption (1000 mt)			Stocks (1000 mt)					
Country		Constant	Time	Price	R ²	Constant	Time	Price	R ²	Constant	Time	Price	R ²
Italy		968,637	17,992 (2.478)	N.S. ^{1/}	.36								
United Kingdom						2,706,519	66,895 (2.066)	-2,464.65 (-.6237)	.19	212,878	50,284 (1.934)	-5,165 (-1.490)	.21
Central America and Caribbean										73,152	16,411 (4.771)	-1,157 ^{2/} (-2.524)	.59
Cuba		3,442,446	120,288 (2.756)	N.S.	.39	253,272	21,402 (5.143)	-3,955 (-.985)	.63				
Dominican Republic										150,247	4,539 (2.028)	W.S. ^{2/}	.21
India						1,518,468	143,070 (10.980)	N.S.	.86				
Philippines						209,519	28,245 (15.193)	-3,800 (-.850)	.95	54,598	11,142 (5,656)	N.S.	.72
Republic of China		45,847	12,267 (6.385)	N.S.	.58								
South Africa						552,623	19,633 (11.739)	N.S.	.87				
Spain		174,399	194,782 (5.262)	678 (.148)	.64								
Rest of the World		6,441,072	4,506,971 (18.097)	118,538 (1.744)	.84	12,302,070	584,647 (38,586)	W.S.	.99	3,181,448	153,766 (8.151)	-40,632 (-2.233)	.89
EEC		4,285,116	1,427,532 (5.623)	46,417 (1.497)	.72	7,644,923	166,039 (12.503)	-6,453 (-.5040)	.92	1,518,109	27,734 (2.035)	-34,304 (-2.610)	.53
Eastern Europe		2,885,091	639,772 (5.723)	1,604 (.1183)	.82	2,195,117	150,749 (33.270)	W.S.	.95	551,298	30,848 (5.867)	-18,627 (-3.673)	.65
OPEC ^{4/}		798,316	62,305 (9.001)	12,510 (1.863)	.88	883,411	72,260 (13.624)	W.S.	.93	791,177	100,348 (1.755)	-19,028 (-2.497)	.30

^{1/} N.S. = Did not enter the stepwise regression at an exclusion level of .95.^{2/} W.S. = Variable was excluded since implausible signs were obtained with inclusion.^{3/} Price lagged 2 years.^{4/} Some OPEC member countries were included in the data series in an "Other Africa" or "Other Asia" category. These countries were projected separately and added to the estimates yielded by the above equations. The values of the countries projected separately were then subtracted from projections for the "Rest of the World."

Note: Other and major exporter category projections were estimated by adding the separate projections of countries in these categories; therefore no regression results are listed.

TABLE 5
PROJECTIONS OF WORLD SUPPLY AND DEMAND FOR SUGAR
1980

1 of 3

Country	Price Scenario (¢/lb)	Hectarege (1000 hectares)	Production	Beginning Inventories	Supply (1000 mt)	Excess Supply (1000 mt)	Consumption	Ending Inventory	Demand	Excess Demand
France	7 15 23	424 587 661	3,052 3,945 4,445	444 299 194	3,496 4,244 4,599	603 1,544 2,093	2,442 2,398 2,353	451 302 153	2,893 2,700 2,506	- - -
Italy ^{1/}	7 15 23	- 289 -	- 1,454 -	539 489 438	1,993 1,943 1,892	- - -	2,238 2,164 2,091	543 491 438	2,781 2,655 2,529	788 712 637
United Kingdom ^{3/}	7 15 23	184 191 198	1,058 1,097 1,135	- 118 -	1,176 1,215 1,253	- - -	2,907 2,888 2,868	230 225 219	3,137 3,113 3,087	1,961 1,898 1,834
Federal Republic of Germany	7 15 23	348 422 463	2,756 3,337 3,663	265 209 153	3,021 3,546 3,816	- 727 1,251	2,806 2,609 2,412	267 210 153	3,073 2,819 2,565	52 - -
Argentina	7 15 23	266 350 398	1,346 1,775 2,016	203 121 39	1,549 1,896 2,055	226 679 945	1,111 1,095 1,078	212 122 32	1,323 1,217 1,110	- - -
Australia	7 15 23	245 316 356	2,791 3,602 4,057	346 330 313	3,137 3,932 4,370	1,917 2,764 3,255	898 865 831	322 303 284	1,220 1,168 1,115	- - -
Brazil	7 15 23	865 1,210 1,404	6,816 9,535 11,060	1,520 1,333 1,147	8,336 10,868 12,207	1,564 4,531 6,306	5,180 4,985 4,789	1,592 1,352 1,112	6,772 6,337 5,901	- - -
Central America and Caribbean	7 15 23	413 458 503	2,053 2,276 2,498	159 158 157	2,212 2,434 2,655	1,332 1,578 1,823	718 695 672	162 161 160	880 856 832	- - -
Cuba ^{1/}	7 15 23	- 1,540 -	- 6,570 -	343 314 285	6,913 6,884 6,855	5,756 5,786 5,817	803 772 740	354 326 298	1,157 1,098 1,038	- - -
Dominican Republic	7 15 23	148 163 177	1,165 1,279 1,391	228 205 181	1,393 1,484 1,572	971 1,089 1,206	189 185 180	233 210 186	422 395 366	- - -

TABLE 5 (Continued)

1980

2 of 3

Country	Price Scenario (\$/lb)	Hectareage (1000 hectares)	Production	Beginning Inventories	Supply (1000 mt)	Excess Supply	Consumption	Ending Inventory	Demand	Excess Demand
India ^{2/ 3/}	7 15 23	2,474 2,637 2,799	4,956 5,281 5,607	- 934 -	5,890 6,215 6,541	- 25 470	- 5,238 -	1,102 952 833	6,340 6,190 6,071	450 - -
Mexico	7 15 23	547 603 634	2,616 2,881 3,030	406 292 177	3,022 3,173 3,207	- 137 379	2,802 2,740 2,678	442 296 150	3,244 3,036 2,828	222 - -
Philippines ^{3/}	7 15 23	395 498 555	2,052 2,584 2,883	- 350 -	2,402 2,934 3,233	1,101 1,664 1,993	946 915 885	- 355 -	1,301 1,270 1,240	- - -
Republic of China	7 15 23	114 126 138	945 1,044 1,142	85 50 15	1,030 1,094 1,157	510 642 773	429 399 370	91 53 14	520 452 384	- - -
South Africa ^{2/}	7 15 23	183 186 189	1,835 1,865 1,894	226 220 214	2,061 2,085 2,108	765 796 826	- 1,064 -	231 225 218	1,295 1,289 1,282	- - -
Poland	7 15 23	430 452 473	2,043 2,144 2,246	241 236 231	2,284 2,380 2,477	162 322 483	1,887 1,829 1,770	235 229 224	2,122 2,058 1,994	- - -
Indonesia	7 15 23	145 176 194	930 1,125 1,234	399 355 312	1,329 1,480 1,546	- - 203	1,532 1,293 1,054	406 347 289	1,938 1,840 1,843	609 160 -
Iran	7 15 23	122 152 181	503 623 743	386 440 274	889 953 1,017	- - -	2,423 1,677 932	915 1,010 1,105	3,338 2,887 2,037	2,449 1,734 1,020
Canada	7 15 23	35 37 39	147 156 164	182 170 159	329 326 323	- - -	1,152 1,129 1,106	183 171 158	1,335 1,300 1,264	1,006 974 941
Japan	7 15 23	74 99 113	571 766 876	230 209 189	801 975 1,065	- - -	3,737 3,505 3,252	232 211 190	3,989 3,716 3,442	3,188 2,741 2,378

TABLE 5 (Continued)

1980

3 of 3

Country	Price Scenario (\$/lb)	Hectareage (1000 hectares)	Production	Beginning Inventories	Supply (1000 mt)	Excess Supply	Consumption	Ending Inventory	Demand	Excess Demand
Spain	7 15 23	203 210 216	814 819 825	198 165 131	1,012 984 956	- - -	1,347 1,263 1,179	207 170 133	1,554 1,433 1,312	542 449 356
Rest of the World ^{2/}	7 15 23	5,707 5,954 6,200	21,954 22,902 23,851	8,102 7,784 7,466	30,056 30,686 31,317	- - -	- 32,660 -	8,268 7,943 7,618	40,928 40,603 40,278	10,872 9,917 8,961
EEC	7 15 23	1,774 1,787 1,801	11,704 11,992 12,179	1,638 1,567 1,512	13,342 13,559 13,691	- - 29	12,561 12,873 12,184	2,027 1,752 1,478	14,588 14,625 13,662	1,246 1,066 -
Major Exporters	7 15 23	7,190 8,087 8,693	33,145 38,632 42,148	4,847 3,954 3,686	37,992 42,646 45,834	13,728 19,658 23,548	19,318 18,953 18,525	4,946 4,035 3,761	24,264 22,988 22,286	- - -
East Europe ^{2/}	7 15 23	1,456 1,461 1,464	4,981 4,994 5,006	982 881 791	5,963 5,875 5,797	- - -	- 6,360 -	997 901 804	7,357 7,261 7,164	1,394 1,386 1,367
OPEC	7 15 23	572 594 595	2,660 2,760 2,768	1,360 1,208 1,055	4,020 3,968 3,823	- - -	4,409 4,199 3,989	1,361 1,210 1,057	5,770 5,409 5,046	1,750 1,441 1,223
USSR	7 15 23	3,425 3,581 3,668	10,750 11,239 11,513	1,067 730 392	11,817 11,969 11,905	- - -	14,128 13,049 11,971	1,126 725 323	15,254 13,774 12,294	3,437 1,805 389
Other ^{4/}	7 15 23	312 346 368	1,532 1,741 1,865	610 544 479	2,142 2,285 2,344	- - -	6,256 5,997 5,537	622 552 481	6,878 6,449 6,018	4,736 4,164 3,674
World Totals	7 15 23	20,436 21,810 22,789	86,726 94,320 99,330	18,606 16,668 15,381	105,332 110,988 114,711	- - 7,963	95,692 93,991 91,226	19,347 17,118 15,522	115,039 111,109 106,748	9,707 121 -

^{1/} No significant price variable in the production equation.^{2/} No significant price variable in the consumption equation.^{3/} No significant price variable in the inventory equation.^{4/} Canada, Japan, and Spain.

TABLE 6
PROJECTIONS OF WORLD SUPPLY AND DEMAND FOR SUGAR
1985

Country	Price Scenario (¢/lb)	Hectareage (1000 hectares)	Production	Beginning Inventories	Supply	Excess Supply (1000 mt)	Consumption	Ending Inventory	Demand	Excess Demand
France	7 15 23	459 594 669	3,167 4,096 4,617	468 313 158	3,635 4,409 4,775	487 1,464 2,034	2,676 2,629 2,582	472 316 159	3,148 2,945 2,741	- - -
Italy ^{1/}	7 15 23	- 305 -	- 1,544 -	559 504 449	2,103 2,048 1,993	- - -	2,532 2,457 2,381	562 507 451	3,094 2,964 2,832	991 916 839
United Kingdom ^{2/}	7 15 23	184 191 198	1,079 1,119 1,159	- 121 -	1,200 1,240 1,280	- - -	2,919 2,899 2,880	278 273 267	3,197 3,172 3,147	1,997 1,932 1,867
Federal Republic of Germany	7 15 23	355 431 473	3,012 3,658 4,020	277 218 158	3,289 3,876 4,178	- 747 1,316	3,115 2,909 2,702	279 220 160	3,394 3,129 2,862	105 - -
Argentina	7 15 23	270 357 405	1,413 1,865 2,119	230 128 27	1,643 1,993 2,146	208 678 952	1,203 1,185 1,167	232 130 27	1,435 1,315 1,194	- - -
Australia	7 15 23	246 318 358	2,791 3,710 4,179	294 270 246	3,085 3,980 4,425	1,807 2,762 3,268	984 948 912	294 270 245	1,278 1,218 1,157	- - -
Brazil	7 15 23	894 1,250 1,450	7,512 10,507 12,187	1,854 1,437 1,021	9,366 11,944 13,208	1,560 4,807 6,740	5,992 5,676 5,461	1,914 1,461 1,007	7,806 7,137 6,468	- - -
Central America and Caribbean	7 15 23	415 461 507	2,127 2,364 2,602	119 109 98	2,246 2,473 2,700	1,378 1,637 1,898	748 725 701	120 111 101	868 836 802	- - -
Cuba ^{1/}	7 15 23	- 1,593 -	- 7,171 -	343 308 285	7,514 7,479 7,456	6,257 6,300 6,328	910 879 847	347 314 281	1,257 1,179 1,128	- - -
Dominican Republic	7 15 23	149 165 180	1,262 1,393 1,524	243 220 197	1,505 1,613 1,721	1,041 1,177 1,313	216 211 206	248 225 202	464 436 408	- - -

I of 3

TABLE 6 (Continued)

1985

2 of 3

Country	Price Scenario (c/lb)	Hectareage (1000 hectares)	Production	Beginning Inventories	Supply (1000 mt)	Excess Supply (1000 mt)	Consumption	Ending Inventory	Demand	Excess Demand
India ^{2/ 3/}	7 15 23	2,488 2,666 2,844	5,457 5,848 6,240	- 1,022 -	6,479 6,870 7,262	- - 361	- 5,954 -	1,417 1,039 954	7,731 6,993 6,908	892 123 -
Mexico	7 15 23	548 604 636	2,646 2,915 3,066	564 317 69	3,210 3,232 3,135	- - -	3,228 3,158 3,089	590 322 55	3,818 3,480 3,144	608 248 9
Philippines ^{3/}	7 15 23	396 499 557	2,067 2,603 2,904	- 408 -	2,475 3,011 3,312	977 1,544 1,875	1,087 1,056 1,026	- 411 -	1,498 1,467 1,437	- - -
Republic of China	7 15 23	114 126 138	948 1,047 1,146	102 58 15	1,050 1,105 1,161	430 562 695	516 483 451	104 60 15	620 543 466	- - -
South Africa ^{2/}	7 15 23	183 186 189	1,934 1,967 2,000	251 244 237	2,185 2,211 2,237	766 801 833	- 1,162 -	256 248 241	1,419 1,410 1,404	- - -
Poland	7 15 23	432 455 478	2,209 2,327 2,445	238 233 227	2,447 2,560 2,672	68 253 436	2,139 2,073 2,007	240 234 229	2,379 2,307 2,236	- - -
Indonesia	7 15 23	148 180 198	1,005 1,219 1,339	437 313 163	1,442 1,532 1,502	- - -	1,815 1,555 1,295	445 304 163	2,260 1,859 1,458	818 327 1,123
Iran	7 15 23	125 158 190	568 716 863	493 381 269	1,061 1,097 1,132	- - -	2,801 1,926 1,050	508 389 269	3,309 2,315 1,319	2,248 1,218 187
Canada	7 15 23	35 37 39	149 157 166	193 179 164	342 336 330	- - -	1,234 1,210 1,185	195 181 167	1,429 1,391 1,352	1,087 1,055 1,022
Japan	7 15 23	76 102 116	612 822 941	241 219 197	853 1,041 1,138	- - -	4,338 4,073 3,809	244 221 199	4,582 4,294 4,008	3,729 3,253 2,870

TABLE 5 (Continued)

1985

3 of 3

Country	Price Scenario (\$/lb)	Hectareage (1000 hectares)	Production	Beginning Inventories	Supply --(1000 mt)--	Excess Supply	Consumption	Ending Inventory	Demand	Excess Demand
Spain	7 15 23	207 214 220	848 853 859	224 181 139	1,072 1,034 998	- - -	1,552 1,464 1,376	226 183 140	1,778 1,647 1,516	706 613 518
Rest of the World ^{2/}	7 15 23	6,390 6,659 6,923	22,748 23,696 24,644	8,847 8,320 7,871	31,595 32,016 32,515	- - -	- 26,360 -	9,037 8,711 8,386	45,397 45,701 44,746	13,862 13,685 12,231
EEC	7 15 23	1,900 1,914 1,927	12,512 12,884 13,255	2,101 1,889 1,572	14,613 14,773 14,827	- - 90	13,512 13,316 13,120	2,165 1,891 1,617	15,677 15,207 14,737	1,064 434 -
Major Exporters	7 15 23	7,296 7,775 8,857	35,328 41,390 45,138	5,506 4,050 3,584	40,834 45,440 48,722	13,379 20,987 24,122	21,900 21,437 20,976	5,555 4,090 3,624	27,455 25,527 24,600	- - -
East Europe ^{2/}	7 15 23	1,548 1,551 1,556	5,093 5,106 5,119	992 871 790	6,085 5,977 5,909	- - -	7,139 -	1,034 937 842	8,173 8,076 7,981	2,088 2,099 2,072
OPEC	7 15 23	638 659 681	2,986 3,086 3,186	1,368 1,216 1,064	4,354 4,302 4,250	- - -	4,957 4,721 4,485	1,370 1,218 1,066	6,327 5,939 5,551	1,973 1,637 1,301
USSR	7 15 23	3,455 3,622 3,716	11,760 12,330 12,650	1,272 729 186	13,032 13,059 12,836	- - -	16,077 14,942 13,807	1,300 734 171	17,377 15,676 13,978	4,345 2,617 1,142
Other ^{4/}	7 15 23	318 353 375	1,609 1,832 1,966	658 579 500	2,267 2,411 2,466	- - -	7,124 6,747 6,370	665 585 506	7,789 7,332 6,876	5,536 4,932 4,419
World Totals	7 15 23	21,545 22,533 24,035	92,036 100,324 105,958	20,744 17,654 15,567	112,780 117,978 121,525	- - 3,055	107,069 104,862 102,257	21,126 18,166 16,212	128,195 123,458 118,469	15,415 5,480 -

^{1/} No significant price variable in the production equation.^{2/} No significant price variable in the consumption equation.^{3/} No significant price variable in the inventory equation.^{4/} Canada, Japan, and Spain.

SUMMARY AND CONCLUSIONS

The world sugar economy is a complicated maze of government policies, trade arrangements, and different consumption patterns. No one equation or set of equations can completely explain the world sugar economy and no such attempt was made in this study. What is attempted is to provide projections for production, demand, and hectarage for 1980 and 1985 using different price scenarios and economically and statistically sound equations to estimate variable parameters.

This update study has utilized much of the information in the Phase II study. The reader is referred to the Phase II document for complete background information on methodology and data sources.

Graphical derivations of the supply and demand situations for 1980 and 1985 appear in Figures 2 and 3. The data utilized to construct these supply and demand curves, which were taken from Tables 5 and 6, appear in Tables 7 and 8.

The excess supply figures for the world totals represent additional carry-over inventories in excess of those necessary for "working" inventories in the world supply and demand situation. Excess supply would serve to decrease production and along with the low supply price, force supply towards the equilibrium level.

The excess demand figures for the world totals theoretically estimate demand in excess of supply. This amount would represent the amount of inventories over and above "working" inventories necessary to meet world demand — an undersupply situation like the disequilibrium that contributed to the rapid price increase in 1974-75.

This analysis indicates an estimated equilibrium price for 1980 of 15.6 cents per lb and for 1985 of 20.2 cents per lb, with supply and demand equilibrium levels of 110.7 million MT and 120.2 million MT, respectively, for 1980 and 1985.

FIGURE 2
GRAPHICAL DERIVATION OF EQUILIBRIUM
WORLD SUGAR PRICE FOR 1980

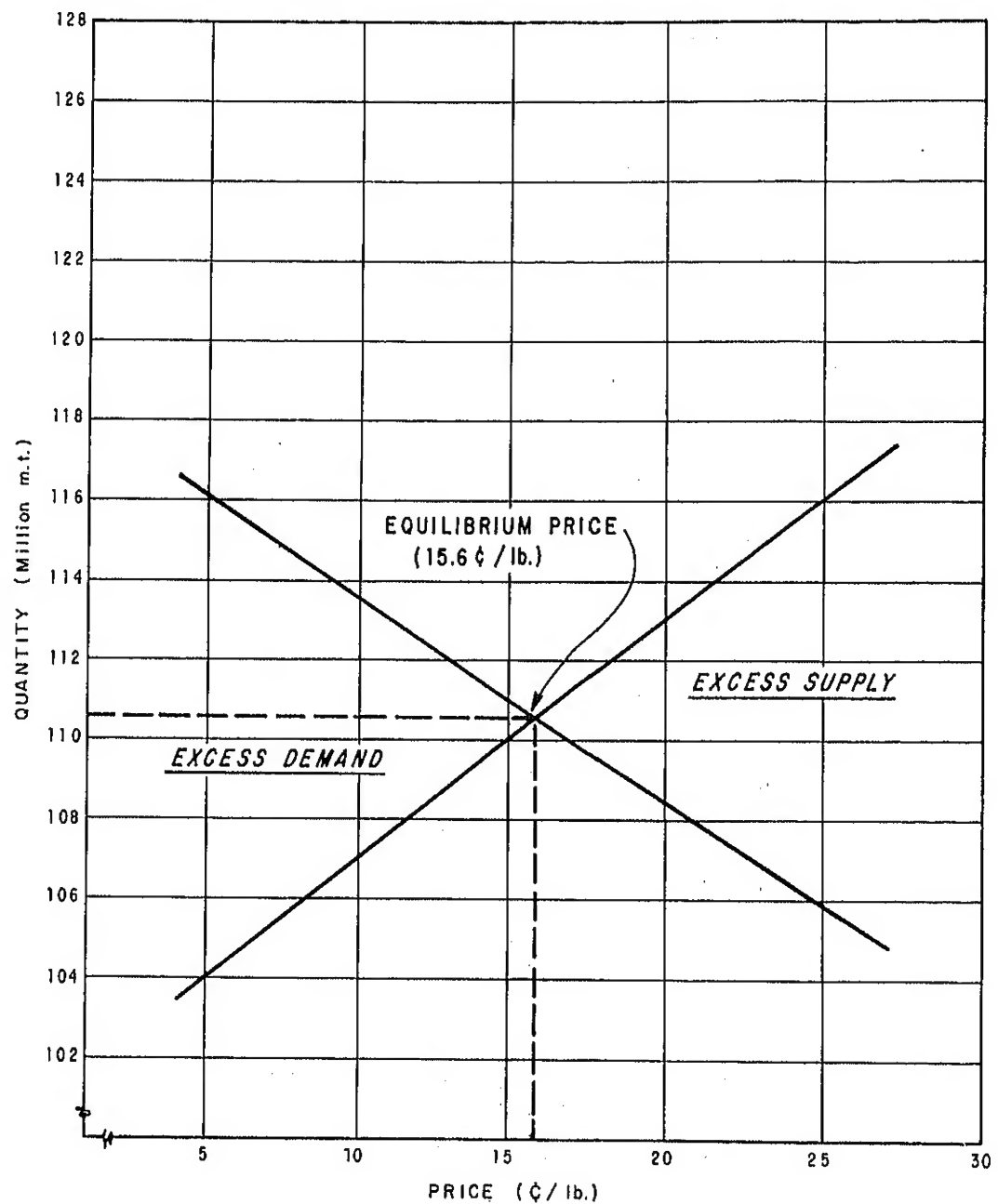


FIGURE 3
GRAPHICAL DERIVATION OF EQUILIBRIUM
WORLD SUGAR PRICE FOR 1985

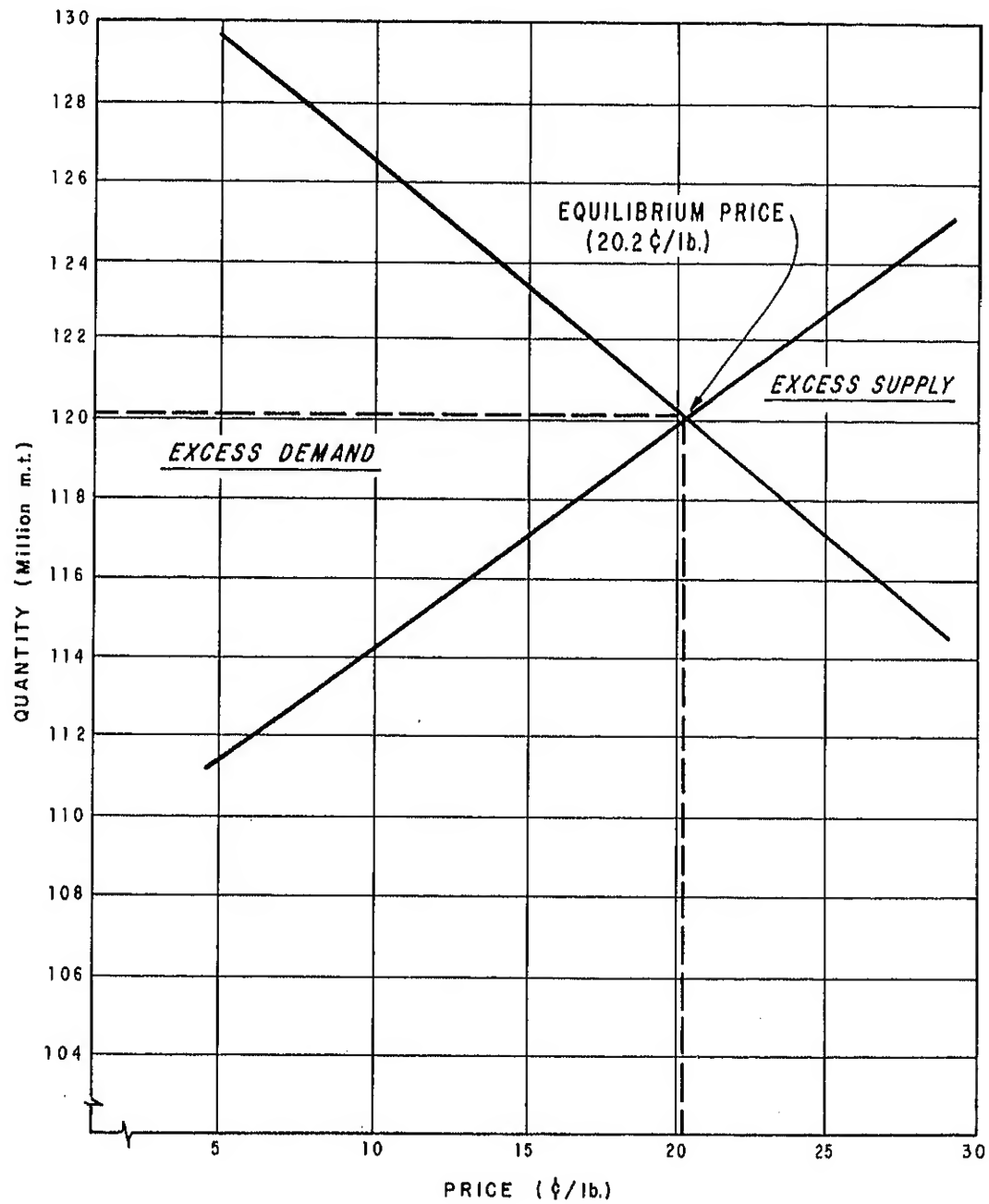


TABLE 7
EQUILIBRIUM SUPPLY AND DEMAND SITUATION FOR THE
WORLD SUGAR ECONOMY IN 1980

Price (¢/lb)	Supply ^{1/} -----	Excess Supply million metric tons	Demand ^{2/} -----	Excess Demand -----
7	105.3	--	115.0	9.7
15	110.0	0	111.1	1.1
15.6 ^{3/}	110.7	--	110.7	--
23	114.7	8.0	106.7	--

^{1/} Supply = quantity produced and beginning inventories

^{2/} Demand = quantity consumed and ending inventories

^{3/} Denotes equilibrium price

TABLE 8
EQUILIBRIUM SUPPLY AND DEMAND SITUATION FOR THE
WORLD SUGAR ECONOMY IN 1985

Price (¢/lb)	Supply ^{1/}	Excess Supply	Demand	Excess ^{2/} Demand
	-----million metric tons-----			
7	112.8	--	128.2	15.4
15	118.0	--	123.5	5.5
20.2 ^{3/}	120.2	--	120.2	--
23	121.5	3.0	118.5	--

^{1/} Supply = quantity produced and beginning inventories

^{2/} Demand = quantity consumed and ending inventories

^{3/} Denotes equilibrium price

Other important findings of this study are as follows:

- Historically, sugar producers and consumers have responded to changes in price; however, some countries do not respond directly to market and economic forces and, for them, supply and demand are difficult to project using equations reflecting price and other economic variables.
- There is evidence that a sugar supply and demand "cycle" do exist.

Evidence of Price Response

A key variable in each of the supply and distribution equations tested was world price. Out of the 63 equations tested for the individual countries, only one country did not respond to price according to theoretical economic considerations (see Table 4). This was the Dominican Republic, which appeared to increase stocks as price increased, contrary to the hypothesized relationship.

This was probably due to the Dominican Republic's traditional reliance on the U.S. market. Maintenance of the U.S. market is important to the sugar industry in this country. Stocks are manipulated for U.S. market maintenance as opposed to maximizing revenues on the open market.

Six other countries did not respond to price as expected. In the equations for these countries, price did not enter a stepwise regression at an inclusion level of .95. They were as follows:

<u>Country</u>	<u>Variable</u>
-- Italy	Production
-- Cuba	Production and consumption
-- Philippines	Stocks
-- Republic of China	Production
-- South Africa	Consumption
-- India	Consumption

Italy is a regular deficit EEC country in sugar production. As such, Italy receives a high derived intervention price designed to encourage production. This creates a large subsidy for production and reflects high production costs. Production costs are such that import sugar can cost considerably less than Italian sugar. The effects of a subsidy and high production costs distort the effects of world price on production decisions and leave world price as an insignificant influence on Italian sugar production decisions.

Cuba's production and consumption situation are regulated by the government. The effects of changing politics in Cuba have caused many fluctuations in the Cuban sugar industry. The embargo on Cuban exports by the United States that began in 1960 produced dramatic changes in the Cuban sugar production situation. An additional problem in projecting Cuban sugar production was encountered in 1970, when production increased by over 54 percent in 1 year due to a government decision to increase sugar production. These and other periodic changes in the Cuban political and trade situation overrode price as a critical explanatory variable for production and consumption in Cuba.

The Philippines, like the Dominican Republic, has traditionally been dependent on the U.S. market. Through 1974 the government attempted to meet the U.S. sugar quota and in some years has had difficulty in reaching this goal. The government has also been known to hold stocks as a speculative move to obtain a higher price. This occurred in 1976. These reasons and others related to control by the Philippine government indicate that their stock management policies cannot be explained by world price.

The Republic of China has had very stable sugar production. Production in 1955 was 755,000 metric tons (raw value) as compared to 819,000 in 1976. The average production over this time period was 856,000 metric tons. Production in the Republic of China is price inelastic and yielded a statistically insignificant price variable for projection purposes.

South Africa's domestic sugar consumption data have been influenced by the injection of brown sugar into the consumer market in 1959/60 and the subsequent growth of consumption by 153,000 metric tons since that time. Data showing the growth of brown sugar consumption are shown in Table 9.

TABLE 9
SOUTH AFRICAN
DOMESTIC SUGAR CONSUMPTION

(in metric tons)			
Year	White	Brown	Total
1955-56	593,508	---	593,508
1956-57	610,105	---	610,105
1957-58	659,521	---	659,521
1958-59	657,474	---	657,474
1959-60	526,101	12,492	655,837
1960-61	561,026	113,615	674,641
1961-62	553,234	122,575	675,809
1962-63	559,189	116,559	675,748
1963-64	601,582	122,854	724,436
1964-65	624,821	127,084	751,905
1965-66	646,909	131,890	778,799
1966-67	638,377	122,243	760,620
1967-68	627,705	106,757	734,462
1968-69	661,459	108,113	769,572
1969-70	678,459	112,012	790,471
1970-71	716,474	118,931	835,405
1971-72	746,154	124,739	870,893
1972-73	777,908	131,144	909,052
1973-74	835,184	145,618	980,802
1974-75	899,063	154,286	1,053,349
1975-76	957,059	164,372	1,121,431
1976-77	980,499	165,141	1,145,640

Source: The South African Sugar Year Book 1976-77

The addition of brown sugar to the consumption picture resulted in further increases in total sugar consumption.

Data utilized in testing the projection equations were for white sugar only. The influx of brown sugar consumption has affected white sugar consumption. As a result, the time series data were reflecting two different variables, one variable for white sugar consumption and the other for brown sugar consumption. This situation could have affected the consumption projection estimates, since a data error was apparent in the series used for the estimates.

Of greater importance, however, is the direct government intervention in domestic retail market supply and prices. The domestic retail market price is fixed by the government and it is insulated from the swings in the international market price. The result is that domestic consumption is not influenced by world price.

India's consumption of white sugar is heavily influenced by the production of artisan non-centrifugal sugars. In fact, non-centrifugal sugars typically account for almost three-fourths of domestic consumption. There is direct competition between the two, with domestic price and government policy being important determinants of the consumption levels of each sugar type. The result is a world price variable that is statistically insignificant due to the domestic competition between white and non-centrifugal sugars and government price intervention.

Another relationship that should be mentioned is the demand situation for Mexico. The supply totals for Mexico in 1985 at first glance seem to indicate that as price increases supply decreases but demand increases. This is contrary to a priori economic knowledge and the projection results obtained for other countries. A closer look at the Mexican projections reveals that the expected relationships between price and the other variables actually do hold. Supply is defined as the sum of production and beginning inventories. Demand is defined as the sum of consumption and ending inventories. All four variables showed statistically significant response to price in the direction that should be expected; i.e. positive for production and negative for consumption and inventories. However, inventories have a much stronger response to price than does production. When supply is calculated the results are that supply declines as price increases due to a decrease in inventories that is greater than the increase in production. The signs in the projection equations were as hypothesized and correct, even though the supply and demand totals seem to defy a priori assumptions.

Evidence of a Sugar Cycle

A 22-year data series (1955 through 1976), such as was used for this study, is probably not sufficient to draw conclusions about a sugar cycle; however, some interesting relationships can be noted. The evidence available consists of the patterns of historical price fluctuations, the historical residuals of world production and consumption, and the derived equilibrium prices for 1980 and 1985 as a result of this study.

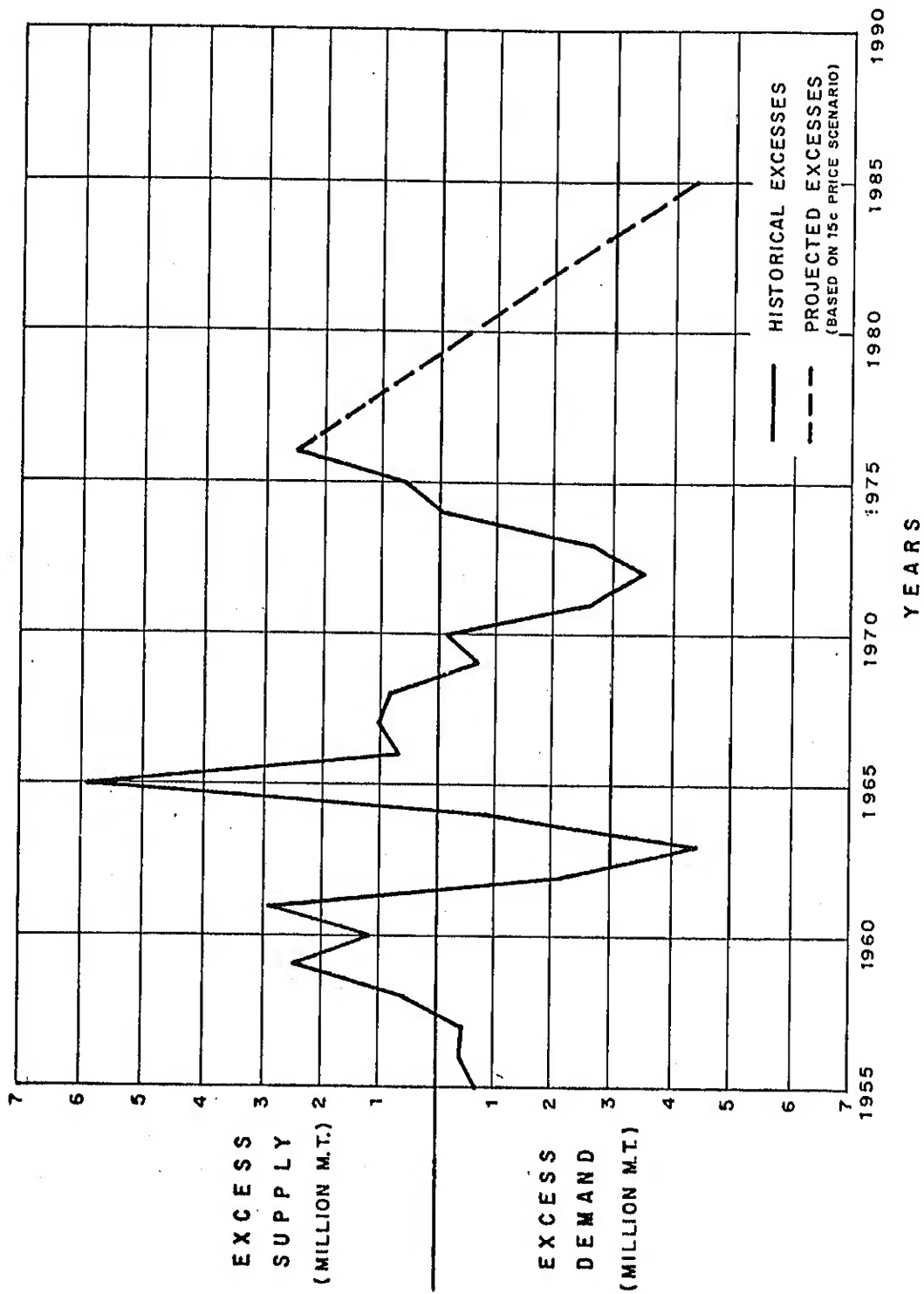
Figure 1 on page 3 plotted world prices from 1955 through 1976. As can be seen from this information, prices seem to fit into a 6-year cycle as indicated by the high points on this chart. The cycle years would end and begin in 1956/57, 1962/63, 1968/69 and 1974/75.

Production and consumption are closely related to world prices in most countries. Given a price cycle, a pattern in production and consumption should exist due to relationships between production, consumption and prices. Historical excess supply and excess demand are plotted in Figure 4. According to the high points in Figure 4, a production and consumption cycle does seem to exist. High points for excess supply (supply less demand) seem to occur approximately 2 years after high points in world price.

Excess supply and demand calculated from the 1980 and 1985 projections indicate a continuance of past cycles (dotted line on Figure 4). Based on a 15 cent scenario, demand in 1980 should be exceeding supply and prices will begin to rise. This will be a result of production decisions based on world prices which began to fall in 1975 and demand which will respond to lower prices. According to past cycles, 1985 is probably close to the height of a period of excess demand.

The notion of a sugar supply and distribution cycle corresponds to economic equilibrium theory in that as price is bid up by excess demand production is stimulated. As supply rises, prices fall and again stimulate demand. The economic forces that cause the cycle and resulting price fluctuations probably can not be controlled by the actions of individual governments. However, knowledge of the cyclic nature of world sugar supply and demand can be a valuable tool when planning sugar production and marketing strategies.

FIGURE 4
HISTORICAL AND PROJECTED EXCESS SUPPLY AND DEMAND 1955 - 1985



PHASE II

ERRATA

The following are errata for the Phase II study entitled "Report on World Sugar Supply and Demand, 1980 and 1985," published in November 1977.

1. There was a typographical error on Table 42, page 279, concerning consumption for the "Rest of the World" category. This did not affect the World Totals, which remain the same. The corrected Table 42 page is reproduced on page 30 of this report.
2. The price utilized in the November 1977 study was a constant 1974 price.
3. Tables 18 and 19 in the Phase II Report on Nicaraguan production costs should have cited the following source: Dr. Philip F. Warnken, "Production Costs and Returns for Major Agricultural Products of Nicaragua; Data Tables for 1972 and 1975."

TABLE 42 (Continued)

3 of 3

Country	Price Scenario (\$/lb)	Hectareage (1000 hectares)	Production	Beginning Inventories	Supply	Excess Supply (1000 mt)	Consumption Inventory	Ending Inventory	Demand	Excess Demand
Spain	7 15 23	207 214 220	848 876 904	243 221 199	1,091 1,097 1,103	- - -	1,564 1,438 1,312	245 223 201	4,809 1,661 1,513	3,718 564 410
Rest of the World ^{1/ 2/}	7 15 23	- 6,659 -	- 25,299 -	8,745 8,240 7,734	34,044 33,539 33,033	- - -	- 36,160 -	8,937 8,531 7,990	45,097 44,591 44,150	11,053 11,252 11,117
EEC	7 15 23	1,900 1,914 1,927	12,439 12,526 12,614	1,943 1,846 1,684	14,382 14,372 14,298	- - -	13,512 13,316 13,120	1,994 1,892 1,709	15,506 15,208 14,829	1,124 836 531
Major Exporters	7 15 23	8,803 10,944 13,084	33,155 41,317 49,478	7,331 6,539 5,746	40,486 47,856 55,224	11,577 20,126 28,672	21,514 21,128 20,742	7,395 6,602 5,810	28,909 27,730 26,552	- - -
East Europe		1,551	5,988	724	6,712	-	7,139	733	7,872	1,160
OPEC	7 15 23	638 659 681	2,986 3,086 3,186	1,368 1,216 1,064	4,354 4,302 4,250	- - -	4,957 4,721 4,485	1,370 1,218 1,066	6,327 5,839 5,551	1,973 1,637 1,301
USSR ^{3/}	7 15 23	4,593 4,851 5,109	13,555 14,316 15,077	- 987 -	14,542 15,503 16,064	- - 246	15,397 15,114 14,830	- 988 -	16,385 16,102 15,818	1,843 799 -
Other	7 15 23	350 362 374	1,928 1,990 2,051	958 902 846	2,886 2,892 2,897	- - -	7,683 7,120 6,558	989 933 877	8,672 8,053 7,435	5,786 5,161 4,538
World Totals	7 15 23	24,038 26,536 29,032	95,350 104,522 113,693	22,056 20,454 18,785	117,406 124,976 132,478	- - 10,271	106,362 104,698 103,034	22,406 20,897 19,173	128,768 125,595 122,207	11,362 619 -

^{1/} No significant price variable in the production equation.^{2/} No significant price variable in the consumption equation.^{3/} No significant price variable in the inventory equation.

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